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Assessment of nasal obstruction. A comparison between rhinomanometry and nasal inspiratory peak flow

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SUMMARY

In several conditions objective assessment of nasal obstruction would be of great value. In this study we have compared two different methods for this purpose. Anterior rhinomanometry is a well established method, which measures nasal airway resistance (NAR). This was compared with nasal inspiratory peak flow (NIPF) measured with a Youlten peak flow meter. The assessments were undertaken in patients with allergic rhinitis, before and after challenge with hyperosmolar saline solution. After challenge there was a fall in NIPF value as a mean of 17.4%, that was mirrored by a rise in NAR of 15.6%. There was also a statistically significant negative linear correlation between these two methods ($p < 0.01$). We conclude that NIPF is a cheap, easily performed and quick method suitable for assessing nasal airway patency in e.g. allergics during treatment and during challenge.

INTRODUCTION

Nasal obstruction is a common complaint in E.N.T.-practice, but the development of reliable methods for objective assessment of this condition has been slow. Most practitioners consequently still rely on the clinical history and simple rhinoscopy. There are, however, several conditions where an objective assessment would be of great value, e.g. pre- and postoperative assessment, allergologic investigation (response to challenge, desensitization and medication), investigation of functional nasal problems, environmental studies and medicolegal assessment. Rhinomanometry has been used to measure the nasal airway resistance (NAR) since the late 1950s (Aschan et al., 1958). It has proved to be useful in preoperative assessment of nasal skeletal obstruction in patient selection for surgery (Broms et al., 1982, Holmström and Kumlien, 1988). However Wihl and Malm (1985) did not find rhinomanometry more useful than other standard methods (as rhinoscopy, counting of sneezes, measurement of secretion and registration of symptoms) in detecting a positive reaction in allergen challenge. Although rhinomanometry is a reliable method (Mygind, 1980) it has not entered general clinical practice since it has the disadvantages of being time-consuming, rather expensive, requires technical assistance and is not easily portable.

In 1973 Taylor et al. described the nasal expiratory peak flow meter, comparable to the method used orally for detecting pulmonary obstruction. They found a good correlation with this method compared to NAR, as did Frölund et al. (1987).

In 1980 Youlten presented the nasal inspiratory peak flow meter (NIPF) that has obvious hygienic advantages over the expiratory flow device.

Since NIPF is a cheap, simple and easily performed method it seemed appropriate to correlate it with anterior active rhinomanometry, used routinely in a rhinology research clinic.

MATERIALS AND METHODS

22 patients, allergic to either grass pollen and/or house dust, with a positive skin prick test and a corresponding history, participated in the study. None of the participants had asthma or airways obstruction on spirometry. Allergics with septal perforations or total nasal obstruction on one or both sides were not included in the study since anterior rhiomanometry can not be used in these conditions.

Pollen-sensitive patients were assessed twice, outside and during their major allergen season, with anterior active rhinomanometry followed immediately by NIPF.

On each occasion following baseline readings participants were challenged with hyperosmolar saline solution (2.7%, 5 ml intranasally on each side) and rhinomanometry and NIPF values were repeated. Hyperosmolar saline has previously been shown to provoke histamine release in atopic subjects in contrast to non atopics (Krayenbuhl et al., 1989).

Active anterior rhinomanometry was performed with the participant in a sitting position after an adequate period of rest. This was done with a Mercury NR6 rhinomanometer (Mercury Electronics Ltd, Glasgow, Scotland), which has been in routine clinical practice for several years. The resistance is estimated as the quotient between the pressure drop in the nose during inspiration and the flow. Pressure is recorded in one nostril with a catheter connected with adhesive tape. Flow is measured through the other open nasal cavity. All measures were made with a constant pressure of 150 Pascal, according to the European Committee for Standardisation of Rhinomanometry (Clement, 1984). The total NAR was estimated after the average of four readings on both left and right nasal cavities were taken.

For measures of NIPF a Youlten nasal inspiratory peak flow meter (Airmed, London, England), was used. This is an inverted expiratory peak flow meter,

enclosed in a plastic case. Three maximal inspiratory efforts were made from which a mean value was calculated, according to Wihl and Malm (1988). All measures were made in a sitting position.
In 17 of 22 patients challenge was made on two different occasions. In five house dust allergics challenge was only made once. Consequently 78 measures were performed with both rhinomanometry and NIPF since each participant was measured both before and after challenge at each visit.

RESULTS

All 22 patients were able to use the NIPF meter to obtain reproducible measurements with a coefficient of variation of less than 10%. In the group as a whole the NIPF mean value pre-challenge was 139.7±58.6 l/min (Table 1), after hypertonic saline challenge this fell to 115.4±44.7 l/min, a fall of 17.4%. This difference is significant ($p=0.04$, t-test).

Table 1. Nasal inspiratory peak flow (NIPF) values (l/min, mean±SD) and nasal airway resistance (NAR) (kPa/l/s, mean±SD), before and after challenge with hyperosmolar saline in patients with allergic rhinitis. The values for grass pollen allergics tested before and during season are given separately. The changes in NIPF and NAR values after challenge were not statistically significant (t-test) except for NIPF values in the whole group ($p<0.05$).

	all patients (n=22)		grass pollen allergics (n=8) before season		grass pollen allergics (n=8) during season	
	before challenge	after challenge	before challenge	after challenge	before challenge	after challenge
NIPF	139.7 (±58.6)	115.4 (±44.7)*	128.9 (±41.1)	113.5 (±45.4) N.S.	125.0 (±54.9)	107.6 (±48.5) N.S.
NAR	0.30 (±0.16)	0.35 (±0.19) N.S.	0.28 (±0.08)	0.33 (±0.09) N.S.	0.26 (±0.12)	0.29 (±0.08) N.S.

*=$p<0.05$

The pollen sensitive patients tested outside their allergen season had an original mean NIPF value of 128.9±41.1 l/min which fell by 11.9% on hypertonic saline challenge ($p=0.49$). When re-tested during the grass pollen season the initial values were 125.0±54.9 l/min, dropping to 107.6±48.5 l/min ($P=0.51$). This 13.9% change is not significantly different from the extra seasonal one.
NAR showed a statistically significant negative linear correlation with the NIPF values (Figure 1), ($r=0.35$, $t=3.26$, $p<0.01$). The changes in NAR with hypertonic saline challenge mirrored those with NIPF, the mean resistance of the whole group showing a 15.6% rise (Table 1).

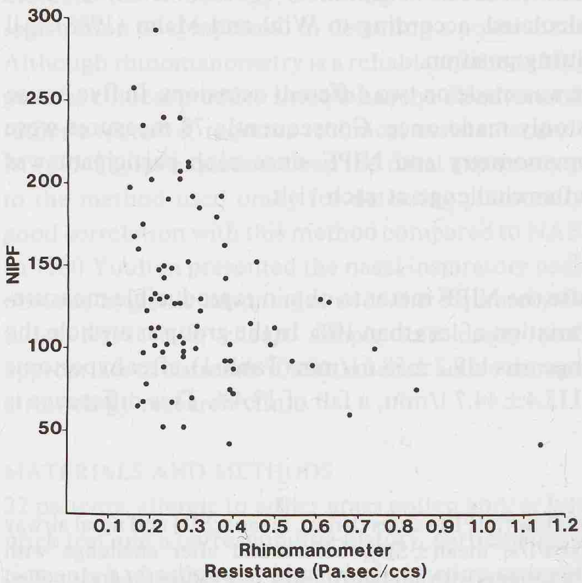

Figure 1. The correlation between nasal inspiratory peak flow (NIPF) and nasal airway resistance (NAR) in 22 patients with allergic rhinitis tested before and after challenge with hyperosmolar saline as well as before and during season. There was a statistically significant negative correlation between the tests, $p<0.01$ ($r=0.35$, $a=166.4$, $b=-112.4$, $n=78$).

DISCUSSION

Obviously there are frequent situations when it is of great value to assess the degree of nasal obstruction. In this study we have compared two methods that can be used for this purpose.

Rhinomanometry is a well established method to assess nasal airway resistance. However, the method has not been used clinically to any degree in the U.K. Although rhinomanometry is an acceptable safe method to assess nasal airway resistance with an acceptable small error of the method (Sandhamn, 1988, Holmström and Kumlien, 1988), it is time-consuming, demands an experienced laboratory assistant, is not easily transportable and the equipment is rather expensive. There are also different external factors that interfere with the results such as airleaks, instrumental calibration and the effects of posture and nasal cycle.

Consequently the use of a reliable, cheap and simple method for assessing nasal airway patency and its response to challenge in an outpatient setting would be of value. This small study was undertaken to determine whether the NIPF meter fulfilled these criteria and in particular to establish whether the results correlated well with those obtained by rhinomanometry. Our results show a reasonable correlation ($p<0.01$) and a comparable percentage change with hypertonic saline challenge.

Nasal challenge with hypertonic saline has been shown to increase nasal obstruction and provoke histamine release in atopics, but not in normal controls (Krayenbuhl et al., 1989). In this study there was a tendency for the NIPF to fall and the NAR to rise following such challenge, but this failed to reach significance. There was no evidence of increased sensitivity to hypertonic saline during the allergen season, compared to extra seasonal measurements.

NIPF could be a useful alternative method for repeated measurements in patients with allergies during treatment and during challenge as a complement to self-assessment. NIPF is an easily performed method, cheap, readily available, quick and portable so it is possible to use it at home after instruction. Thus any late response to challenge could be assessed more readily.

NIPF values cannot be obtained on every individual. Most patients in this study were able to achieve repeatable values after less than five minutes instruction. However, 6% of voluntary controls in a separate series of outpatients at our clinic proved incapable of this and among patients with allergic rhinitis we found in another series that 31 out of 143 proved incapable to perform a NIPF test. Failures were due to severe nasal obstruction, poor coordination of the patient, alar collapse or poor inspiratory reserve.

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